Disease-modeling as a tool for surveillance, foresight and control of exotic vector borne diseases in the Nordic countries

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Modeling the potential transmission intensity of insect borne diseases with climate driven R0 process models is frequently used to assess the potential for veterinary and human infections to become established in non endemic areas. Models are often based on mean temperatures of an arbitrary time period e.g. a monthly temperature mean. Average monthly temperatures are likely to be suitable for predicting permanent establishment of presently exotic diseases. But mean temperatures may not predict the true potential for local spread or limited outbreaks resulting from accidental introductions in years with temporary periods of warm weather. This is particular true for the relatively cool Nordic countries where periods of suitable temperatures, the 'windows of opportunity for transmission', may be very short and only appear in odd years
DTU-Veterinary Institute is developing a system for continuous risk assessment of the potential for local spread of exotic insect borne diseases of veterinary and human importance. In this system R0-models for various vector borne diseases are continuously updated with spatial temperature data to quantify the present risk of autochthonous cases (R0>0) and the present risk of epidemics (R0>1) should an infected vector or host be introduced to the area. The continuously updated risk assessment maps function as an early warning system allowing authorities and industry to increase awareness and preventive measures when R0 raises above the level of 'no possible transmission' and target costly active serological surveillance to these limited periods of potential risk, thus dramatically reducing the number of samples collected and analysed. The risk estimated from the R0 modelling may be combined with the risk of introduction from neighbouring countries and trading partners to generate a truly risk based surveillance system for insect borne diseases.
We have also used the R0 models to predict the potential impact of climate change on four selected vector borne disease: Bluetongue in cattle, African Horse Sickness in horses, Dirofilariasis in dogs and Vivax-malaria in humans. Both the presently very restricted potential spatial and seasonal distribution was predicted to increase in the coming 50 years. While the predicted new areas potentially affected by vector borne diseases are relatively small they closely follow the spatial distribution of human habitation and agriculture. The practical impact of climate change on human health and agriculture may therefore be greater than simple distribution maps suggest.
This presentation will demonstrate the system for selected vector borne diseases, compare the predicted R0 with the actual spread of bluetongue in Scandinavia i 2008, and discuss the level of preventive measures needed to prevent large scale epidemics in the future.